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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/781,920	02/20/2004	Odo Wunnicke	INF-138	5298

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EXAMINER

RAYMOND, BRITTANY L

ART UNIT	PAPER NUMBER
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1756

DATE MAILED: 11/03/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/781,920

Applicant(s)

WUNNICKE ET AL.

Examiner

Brittany Raymond

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on ____.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-20 is/are pending in the application.
- 4a) Of the above claim(s) ____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) ____ is/are allowed.
- 6) ☒ Claim(s) 1-20 is/are rejected.
- 7) ☐ Claim(s) ____ is/are objected to.
- 8) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 20 February 2004 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. ____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date 8/18/2004.
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. ____.
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: ____.

DETAILED ACTION

Specification

1. The disclosure is objected to because of the following informalities: The acronym "DRAMs" was not defined prior to its use (Paragraph 0008).

Appropriate correction is required.

Claim Rejections - 35 USC § 112

2. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

3. Claim 8 is rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. The specification explains that the cationic surfactant is used as a bromide of hydrogensulfate. The words "used as" make it unclear as to whether the cationic surfactant is a bromide or hydrogensulfate or not.

4. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

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5. Claim 8 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. The use of the words "used as" when describing the cationic surfactant make it unclear as to whether the cationic surfactant is a bromide or hydrogensulfate. The examiner is interpreting the language to mean that the cationic surfactant is a bromide or hydrogensulfate and will make a rejection in this way.

Claim Rejections - 35 USC § 103

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

7. Claim 1-7, 9, 10, and 13 - 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hyon (U.S. Patent Application 2004/0072108) in view of Torek (U.S. Patent 6599683).

Hyon discloses a method of forming a resist pattern on a semiconductor device, comprising the steps of: coating a photoresist onto a wafer, which could be assumed to be a single layer as described in Claim 9 of the application, exposing the wafer, developing the exposed photoresist with developer so that a pattern is formed, cleaning the wafer with deionized water which contains a fluorocarbon surfactant to prevent pattern collapse, as stated in the abstract, and evaporating the liquid off of the wafer (Claim 2). This method is very similar to the process described in Claims 1 and 16 of the application. It is also noted that the wafer is exposed using a 365 nm, 248 nm, 193 nm, or 157 nm light source (Claim 2), which is within the range of the exposure recited in Claim 13 of the application. Hyon also discloses that the rinsing step could have two sub steps. The first includes washing the wafer with deionized water to remove the developer, as stated in Claims 2, 17 and 20 of the current application, and the second includes rinsing the wafer with a mixture of the fluorocarbon surfactant dissolved in the deionized water (Paragraph 0029). The two-step rinsing process is similar to the process disclosed in Claims 4 and 19 of the application. Finally, Hyon discusses that a previous invention aimed to control resist pattern collapse by using a vibrator to make the contact angle 90 degrees (Paragraph 0008). This is the same as what is recited in Claim 14 of the application.

Hyon fails to disclose the step of applying a cationic surfactant to the wafer, which occurs during the rinsing process. Hyon also fails to disclose that the rinsing solution containing the cationic surfactant is left on the resist for 10 to 120 seconds, the cationic surfactant is a trimethylalkylammonium salt whose alkyl group comprises more

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than 8 carbon atoms, the photoresist is a positive photoresist, the concentration of the cationic surfactant is the cause of the 90 degree contact angle, the concentration of the cationic surfactant in the rinsing medium is less than the critical micelle concentration, and that the cationic surfactant is present in both rinsing steps.

Torek discloses a method for patterning a photoresist comprising: applying a photoresist to a substrate, selectively exposing the photoresist to actinic radiation, developing the photoresist with a developer that includes a surfactant to prevent pattern collapse as stated in the abstract, and which can be cationic, as stated in line 52 of column 3 of the detailed description, rinsing the photoresist pattern, and drying the photoresist pattern (Claim 45), all of which are similar to what is stated in Claim 1 of the current application. Torek also discloses that the developer is left on for one second to five minutes (Column 5, Line 30) which includes the range of time recited in Claim 5 of the application, the photoresist is a positive photoresist (Column 4, Line 29) as stated in Claim 10 of the application, the concentration of the surfactant is less than the critical micelle concentration (Column 3, Line 45) as stated in Claim 15 of the application, and the cationic surfactant can be dodecyltrimethylammonium chloride or hexadecyltrimethylammonium chloride (Column 3, Lines 55 and 58), which are trimethylalkylammonium salts with alkyl groups having more than 8 carbon atoms, as stated in Claim 7 of the application. They also have tertiary ammonium groups, which is stated in Claim 6 of the application.

It would have been obvious to one of ordinary skill in this art, at the time of invention by applicant, to have modified the process of forming a resist pattern on a

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semiconductor suggested by Hyon by using a cationic surfactant, as suggested by Torek, in the 2nd rinsing sub step because a cationic surfactant can have the same effect of preventing pattern collapse as the fluorocarbon surfactants listed in the Hyon application. It would have also been obvious to include the cationic surfactant, suggested by Torek, in both rinsing sub steps because this would give the cationic surfactant more exposure time to the patterned resist film to further help prevent pattern collapse. Leaving the cationic surfactant solution on for 10 seconds to 2 minutes, as similarly suggested by Torek, would have been obvious because it gives the solution more time to thoroughly absorb into the resist pattern. Along with this, it would have been obvious to use a trimethylalkylammonium salt whose alkyl group comprises more than 8 carbon atoms and whose ammonium group is tertiary, the concentration of this being less than the critical micelle concentration, as suggested by Torek, because the trimethylalkylammonium salts are being used to lower surface tension to prevent pattern collapse, which is what the current application is trying to prevent, and concentrations of these that are less than the critical micelle concentration will help the surfactants do their job of preventing pattern collapse more efficiently. Finally, it would have been obvious to have used a positive photoresist, as suggested by Torek, because it is stated that a positive or negative photoresist can be used with the solution that is being applied (Column 4, Line 27), which contains the same cationic surfactant as suggested in the application.

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8. Claim 11 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hyon (U.S. Patent Application 2004/0072108) in view of Torek (U.S. Patent 6599683) as applied to claims 1-7, 9, 10, and 13 - 20 above, and further in view of Simons (U.S. Patent 6656666).

Hyon and Torek are relied upon as discussed in the rejection of Paragraph 7, set forth above, for their teachings for a method of patterning a photoresist on a semiconductor device.

Hyon and Torek fail to disclose that the photoresist used is a chemically amplified photoresist.

Simons discloses a method of stabilizing a developed resist image comprising: providing a wafer, applying photoresist to the wafer, and imaging the photoresist (Claim 2), as well as developing the resist image, rinsing the resist image with rinse fluid, and critical point drying the fluid from the resist (Claim 1). Simons also discusses that in prior art, chemically amplified resists are used in the process of forming resist images (Column 1, Line 41).

It would have been obvious to one of ordinary skill in this art, at the time of invention by applicant, to have modified the process of patterning a photoresist on a semiconductor device by Hyon and Torek by using a chemically amplified photoresist as suggested by Simons because chemically amplified resists are used when exposed to light with 248, 193, or 157 nm wavelengths (Column 1, Line 67), which is in the range of wavelengths suggested by Claim 13 of the application.

9. Claims 8 and 12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hyon (U.S. Patent Application 2004/0072108) in view of Torek (U.S. Patent 6599683) as applied to claims 1-7, 9, 10, and 13-20 above, and further in view of Messick (U.S. Patent 6451510).

Hyon and Torek are relied upon as discussed in the rejection of Paragraph 7, set forth above, for their teachings for a method of patterning a photoresist on a semiconductor device.

Hyon and Torek fail to disclose that the cationic surfactant is used as a bromide or hydrogensulfate and that the structure elements of the resist mask have an aspect ratio of greater than 3.

Messick discloses a method for developing a photoresist pattern on an electronic component substrate comprising: coating a photoresist film on an electronic component substrate, exposing the photoresist film, developing the photoresist film with a developer composition to form a photoresist pattern, rinsing the developed substrate with a rinse water solution containing an anionic surfactant, and drying the developed substrate (Claim 1). Messick also discloses that the semiconductor wafers having small feature sizes are characterized by high aspect ratios greater than about 3 (Column 4, Line 15), as suggested in Claim 12 of the application. Finally, Messick discloses that the solubilizing groups used in the anionic surfactants can be hydrogensulfate (Column 6, Line 45), as suggested in Claim 8 of the application.

It would have been obvious to one of ordinary skill in this art, at the time of invention by applicant, to have modified the process of patterning a photoresist on a

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semiconductor device by Hyon and Torek by making sure that the semiconductor wafers having small features sizes are characterized by aspect ratios greater than 3, as suggested by Messick, because semiconductors having an aspect ratio greater than 3 have a high chance of pattern collapse, and this is what the invention is trying to prevent. It would have also been obvious to have used hydrogensulfate as the solubilizing group for the surfactant, as suggested by Messick, because Messick shows that it is used as the solubilizing group for an anionic surfactant and cationic surfactants are similar to these and are used to accomplish similar tasks.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Brittany Raymond whose telephone number is 571-272-6545. The examiner can normally be reached on Monday through Friday, 8:00 a.m. - 4:30 p.m. EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark Huff can be reached on 571-272-1385. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

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